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Length–weight relation of fish species occurring on along Auati-Paraná channel in middle Solimões, Amazonas, Brazil

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ABSTRACT

Length-weight relationships were estimated for 47 fish species for Auati-Paraná channel in Central Brazilian Amazonia. Sampling was carried quarterly during 2013 year, using seine net (3 mm stretch mesh size) for the collections in floating vegetation and hand nets in litter of the littoral zone. This study provides new information on the length–weight relationships for 31 species, in addition, provides the new maximum standard lengths for six species.

Keywords: Ichthyofauna; Neotropical fishes; Solimões River Basin.

Relação peso-comprimento das espécies de peixes que ocorrem ao longo do Auati-Paraná no médio Solimões, Amazonas, Brasil

RESUMO

As relações peso-comprimento foram estimadas para 47 espécies de peixes do canal Auati-Paraná na Amazônia Central Brasileira. As amostragens foram realizadas trimestralmente durante o ano de 2013, sendo utilizadas redes de arrasto (malha de 3mm) para as coletas em vegetação flutuante e puças em folhiço da zona litoral. Este estudo fornece novas informações sobre as relações de peso-comprimento para 31 espécies, além de apresentar novos registros de comprimento padrão máximo de seis espécies.

Palavras-chave: Ictiofauna, Peixes Neotropicais, Bacia do Rio Solimões.

Ecological parameters such as the length–weight relation (LWR), from the first step in obtaining estimates on population growth for fish communities, and form a key element in fish biology and ecology research, potentiating fish species biomass estimations from length observations (FROESE et al. 2011). The relationship between these variables, generates information central to the development of models of fish population dynamics (FROESE, 2006), life histories comparisons between fish species and between regions, and reveals biogeographical relationships, as well as providing baseline information for fish stock management strategies and conservation (FROESE et al. 2011; BARROS et al. 2018; CAMARGO et al. 2018; SILVA et al. 2019).

This paper describes the length-weight relationship (LWR) of the 47 species of the fishes from the Auati-Paraná channel, Middle Solimões Basin.

Sampling was carried quarterly during 2013 year, at Auati-Paraná region (2º03'38"S / 66º19'03" W) that is a complex of lakes of different sizes and habitats, and an important link between Solimões and Japurá rivers, Amazonas State, Brazil. Sampling was conducted with seine net (3 mm stretch mesh size) for the collections in floating vegetation and hand nets in litter of the littoral zone. Fish specimens were later identified to species level by consulting the literature (e.g., GERRY, 1977; QUEIROZ, 2013) and specialists were consulted. All scientific names authority and year of description follow Fricke et al. (2020), and all species relationships were checked using Fishbase (FROESE; PAULY, 2020).

The fishes were measured and weighed nearest 0.01 cm and 0.01 g precision. The weight-length relation species were estimated using the equation $W = aSL^b$ (LE CREN, 1951), where *Wt* is the total weight in grams; *L* is the total length in centimeter; *a* is the linear coefficient of the equation; and *b* is the growth coefficient of each species. The equation ($Wt = aSL^b$) was converted into the natural logarithmic form ($\ln W = \ln a + b \ln SL$)) and parameters *a* (regression intercept) and *b* (slope) were calculated using regression analysis (KING, 2007). Presence of outliers for each species was identified graphically using log TL vs log WT plots (FROESE; BINOHLAN, 2000), and obvius outliers removed.

A total of 3,543 specimens from 47 species in 18 families were analyzed. For *Trachelyopterus porosus* (Eigenmann & Eigenmann, 1888) there no records of maximum standard length. All regressions were significant in all species ($p < 0.001$), with the coefficient of determination (r^2) ranging from 0.97 to 0.99. The LWR allometry coefficient (*b*) of the LWR ranged from 2.019 for *Gymnotus jonasi* Albert & Crampton, 2001 to 3.562 for *Pyrrhulina semifasciata* Steindachner, 1876. The median value for *b* was 3.07, with 50% of the values between 2.86 and 3.27 (Table 1).

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Table 1. Length – weight relation of 47 fishes species sampled along the Auati-Paraná channel, Amazonas, Brazil. Bold is a new record of the maximum standard length. / **Tabela 1.** Relação peso-comprimento de 47 espécies de peixes amostradas no canal Auati - Paraná, Amazonas, Brasil. Negrito é um novo registro do comprimento padrão máximo.

ORDER: Family Species	N	SL (cm) Min.	 Máx.	Wt (g) Mín.	 Máx.	a	b	r^2
CHARACIFORMES								
Crenuchidae								
Crenuchus spilurus Günther, 1863	48	1.37	4.24	0.03	1.26	0.0122 (0.0087 - 0.0161)	3.3470 (2.5107 - 3.8362)	0.9712
Erythrinidae								
Erythrinus erythrinus (Bloch & Schneider, 1801)	55	2.28	11.03	0.34	27.77	0.0221 (0.0158 - 0.0300)	2.9863 (2.9142 - 3.6166)	0.9830
Serrasalmidae								
Mylossoma duriventre (Cuvier, 1818)	257	1.30	14.71	0.05	128.20	0.0284 (0.0155 - 0.0547)	3.1058 (1.4974 - 4.8186)	0.9878
Serrasalmus medinai Ramírez, 1965	25	1.46	9.41	0.04	20.70	0.0206 (0.1130 - 0.0308)	3.0659 (1.6051 - 3.9196)	0.9846
Serrasalmus spilopleura Kner, 1858	42	1.35	14.66	0.05	97.50	0.1590 (0.0098 - 0.0350)	3.1486 (2.0968 - 4.1359)	0.9916
Curimatidae								
Curimatopsis microlepis Eigenmann & Eigenmann, 1889	30	1.52	4.40	0.07	2.15	0.0254 (0.0230 - 0.0432)	2.6360 (2.4098 - 2.9953)	0.9701
Potamorhina latior (Spix & Agassiz, 1829)	36	2.46	17.77	0.22	87.93	0.0123 (0.0082 - 0.0157)	3.0681 (2.8084 - 3.2946)	0.9901
Prochilodontidae								
Prochilodus nigricans Spix & Agassiz, 1829	59	1.57	27.04	0.07	550.45	0.0150 (0.0095 - 0.0253)	3.1530 (2.6231 - 3.5399)	0.9944
Lebiasinidae								
Copeina guttata (Steindachner, 1876)	164	1.62	7.08	0.04	6.14	0.0126 (0.0075 - 0.0164)	3.1685 (2.1892 - 3.3703)	0.9829
Pyrrhulina semifasciata Steindachner, 1876	67	1.46	4.44	0.03	1.38	0.0073 (0.0059 - 0.0090)	3.5628 (3.3487 - 3.8279)	0.9819
Pyrrhulina zigzag Zarske & Géry, 1997	63	1.49	3.47	0.03	0.51	0.0089 (0.0075 - 0.0106)	3.2853 (3.0523 - 3.5583)	0.9836
Gasteropelecidae								
Gasteropelecus sternicla (Linnaeus, 1758)	22	1.05	**4.64**	0.05	2.35	0.0439 (0.0356 - 0.0549)	2.4981 (2.0541 - 3.6252)	0.9839
Characidae								
Aphyocharax alburnus (Gnther, 1869)	22	2.97	4.81	0.38	1.14	0.0251 (0.0221 - 0.0273)	2.4494 (2.3478 - 2.5155)	0.9718
Ctenobrycon spilurus (Valenciennes, 1850)	284	1.76	6.45	0.07	4.40	0.0125 (0.0092 - 0.0161)	3.2196 (2.7594 - 3.5066)	0.9803
Gymnocorymbus thayeri Eigenmann, 1908	107	1.48	4.28	0.06	2.14	0.0145 (0.0097 - 0.0192)	3.3410 (2.7077 - 3.7914)	0.9802
Moenkhausia intermedia Eigenmann, 1908	34	1.77	4.90	0.05	2.63	0.0060 (0.0049 - 0.0090)	3.8006 (3.4959 - 4.1821)	0.9837
Moenkhausia melogramma Eigenmann, 1908	20	2.00	**4.08**	0.14	1.55	0.0141 (0.0123 - 0.0169)	3.2228 (3.0466 - 3.4056)	0.9716
Prionobrama filigera (Cope, 1870)	64	2.57	4.97	0.22	1.18	0.0219 (0.0062 - 0.0108)	2.4461 (2.6823 - 2.9526)	0.9803
Tetragonopterus argenteus Cuvier, 1816	45	2.05	8.72	0.18	19.54	0.0178 (0.0110 - 0.0260)	3.2469 (2.7544 - 3.6234)	0.9878
GYMNOTIFORMES								
Sternopygidae								
Eigenmannia trilineata López & Castello, 1966	35	3.22	17.18	0.08	6.03	0.0038 (0.0030 - 0.0050)	2.5616 (2.4415 - 2.7000)	0.9818
Gymnotidae								
Gymnotus arapaima Albert & Crampton, 2001	38	3.27	30.50	0.15	88.55	0.0046 (0.0034 - 0.0078)	2.8581 (2.7387 - 3.1011)	0.9828
Gymnotus jonasi Albert & Crampton, 2001	44	4.49	11.70	0.35	2.38	0.0190 (0.0166 - 0.0212)	2.0190 (1.9396 - 2.0899)	0.9839
Hypopomidae								
Brachyhypopomus beebei (Schultz, 1944)	20	6.08	17.50	0.51	12.14	0.0022 (0.0018 - 0.0027)	2.9541 (2.8711 - 3.0470)	0.9813
Brachyhypopomus bennetti Sullivan, Zuanon, Cox & Fernandes, 2013	77	3.01	21.40	0.11	12.10	0.0060 (0.0041 - 0.0104)	2.5092 (2.2913 - 2.9235)	0.9824
Brachyhypopomus regani Crampton, de, Santana, Waddell & Lovejoy , 2016	26	2.84	6.88	0.54	5.28	0.0236 (0.0206 - 0.0278)	2.8391 (2.7417 - 2.9944)	0.9822
SILURIFORMES								
Callichthyidae								
Callichthys callichthys (Linnaeus, 1758)	48	2.69	10.10	0.51	34.05	0.0204 (0.0169 - 0.0256)	3.1323 (2.9987 - 3.3315)	0.9842
Corydoras elegans Steindachner, 1876	23	2.59	4.48	0.72	3.03	0.0687 (0.0636 - 0.0734)	2.5161 (2.4388 - 2.5802)	0.9866
Corydoras zygatus Eigenmann & Allen, 1942	23	3.10	**6.00**	1.16	7.88	0.0577 (0.0430 - 0.0577)	2.8535 (2.7537 - 2.9566)	0.9829
Dianema longibarbis Cope, 1872	80	4.59	**8.45**	2.23	20.09	0.0115 (0.0010 - 0.0135)	3.4645 (3.3954 - 3.5649)	0.9834
Megalechis thoracata (Valenciennes, 1840)	67	1.70	10.77	0.11	41.19	0.0265 (0.0199 -0.0330)	3.1248 (2.6050 - 3.3060)	0.9905
Loricariidae								
Hypoptopoma gulare Cope, 1878	20	4.29	7.80	0.87	6.50	0.0057 (0.0051 - 0.0064)	3.4494 (3.3872 - 3.5213)	0.9806
Hypostomus carinatus (Steindachner, 1881)	33	1.54	9.22	0.03	14.32	0.0108 (0.0062 - 0.0155)	3.2391 (2.3590 - 3.7661)	0.9831
Rineloricaria phoxocephala (Eigenmann & Eigenmann, 1889)	45	5.03	12.26	0.33	11.93	0.0008 (0.0006 - 0.0010)	3.7790 (3.6499 - 3.9184)	0.9872
Auchenipteridae								
Trachelyopterus galeatus (Linnaeus, 1766)	85	3.23	12.50	0.70	65.34	0.0181 (0.0127 - 0.0291)	3.2114 (2.9681 - 3.6084)	0.9816
Trachelyopterus porosus (Eigenmann & Eigenmann, 1888)	20	4.26	**16.20**	1.48	132.14	0.0156 (0.0115 - 0.0208)	3.2512 (3.0941 - 3.4115)	0.9804
Tympanopleura atronasus (Eigenmann & Eigenmann, 1888)	32	5.20	11.91	1.72	27.61	0.0070 (0.0059 - 0.0081)	3.3117 (3.2228 - 3.3887)	0.9826
Doradidae								
Amblydoras affinis (Kner, 1855)	28	2.74	5.19	0.48	2.85	0.0355 (0.0328 - 0.0391)	2.6672 (2.5884 - 2.7615)	0.9915
Anadoras grypus (Cope, 1872)	293	1.19	14.99	0.04	88.08	0.0264 (0.0179 -0.0409)	2.9706 (2.4358 - 3.4103)	0.9808
Ossancora punctata (Kner, 1855)	21	3.24	7.30	0.75	7.38	0.0280 (0.2470 - 0.0316)	2.7736 (2.6970 - 2.8558)	0.9814
SYNBRANCHIFORMES								
Synbranchidae								
Synbranchus marmoratus Bloch, 1795	195	6.99	52.00	0.18	155.24	0.0001 (0.0003 - 0.0007)	3.3023 (2.9262 - 3.6732)	0.9838
Synbranchus madeirae Rosen & Rumney, 1972	37	3.90	27.70	0.03	24.63	0.0002 (0.0001 - 0.0002)	3.5781 (3.6720 - 3.9739)	0.9924
CICHLIFORMES								
Cichlidae								
Aequidens tetramerus (Heckel, 1840)	64	1.62	12.97	0.05	109.51	0.0281 (0.0164 - 0.0399)	3.2321 (2.7591 - 3.6691)	0.9913
Apistogrammoides pucallpaensis Meinken, 1965	37	0.90	2.50	0.02	0.60	0.0307 (0.0260 - 0.0392)	3.1815 (2.554 - 4.5208)	0.9817
Astronotus ocellatus (Agassiz, 1831)	24	2.20	19.24	0.20	391.52	0.0146 (0.0099 - 0.0461)	3.4903 (3.3157 - 4.0827)	0.9880
Cichlasoma amazonarum Kullander, 1983	600	1.12	11.95	0.04	78.20	0.0285 (0.0154 - 0.0416)	3.2692 (2.5564 - 3.6090)	0.9903
Pterophyllum scalare (Schultze, 1823)	47	2.39	6.37	0.61	9.71	0.0401 (0.0342 - 0.0448)	3.0013 (2.8883 - 3.1182)	0.9901
CYPRINODONTIFORMES								
Rivulidae								
Anablepsoides micropus (Steindachner, 1863)	37	1.36	6.70	0.03	4.93	0.0124 (0.0085 - 0.0161)	3.0936 (2.3359 - 3.5638)	0.9942

This study provides the first biological information for 31 species from the middle Amazon basin, including *Apistogrammoides pucallpaensis* and *Pyrrhulina zigzag* species that had their first occurrence in Brazil registered in this research (OLIVEIRA et al. 2019), and with potential for exploitation in ornamental trade. Besides *Gymnotus arapaima* and *Gymnotus jonasi* two species of electric fish described in the region (ALBERT; CRAMPTON, 2001). All the values of r^2 fell within the expected value 95%, as suggested by Froese (2006).

Data for seven species are should be treated with caution due to the small sample size (< 20 individuals). However, the inclusion of this species in the present paper is justified because the individuals showed a broad length range, enough to obtain the length–weight relationships since the sample was composed of individuals with a length broad enough to obtain robust statistical relationships.

This study provides new information on the length–weight relationships of the ichthyofauna from of the central region Amazon, as well as comprising important baseline data for future studies focused on the management, conservation, and ecology of natural resources within the region.

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